BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(12) UK Patent Application (19) GB (11) 2 328 084 (13) A

(43) Date of A Publication 10.02.1999

(21) Application No 9816105.2

(22) Date of Filing 23.07.1998

(30) Priority Data
(31) 60054497 (32) 31.07.1997 (33) US
(31) 60054373 (32) 31.07.1997

(51) INT CL[6]
H01Q 11/08

(52) UK CL (Edition Q)
H1Q QDJ
U1S S2203 S2213

(56) Documents Cited
US 5258765 A US 4169267 A

(58) Field of Search
UK CL (Edition P) H1Q QAA QAX QDA QDH QDJ QDX QJC
INT CL[6] H01Q 1/36 11/08 21/30
ONLINE : WPI

(71) Applicant(s)
The Whitaker Corporation
(Incorporated in USA - Delaware)
4550 New Linden Hill Road, Suite 450, Wilmington, Delaware 19808, United States of America

(72) Inventor(s)
Scott A Faulkner
Stephen D Gherardini

(74) Agent and/or Address for Service
Baron & Warren
18 South End, Kensington, LONDON, W8 5BU, United Kingdom

(54) Abstract Title
Multiple coil wide band antenna

(57) A multiple band antenna (10) includes a coiled portion having a first coiled section (18), at least one second coiled section (24) and an intermediate portion (30) between and joining adjacent sections (18, 24). The windings of the coiled sections (18, 24) are at selected spacings and the resultant coiled sections are spaced from each other at a distance greater than the spacings between either of the windings. The antenna (10) can be tuned to receive frequencies in at least two bands. The antenna can further include a rod portion (40), retractable through the coiled portion.

A further third coiled section and second intermediate portion may be included to enable tuning to receive in three bands.

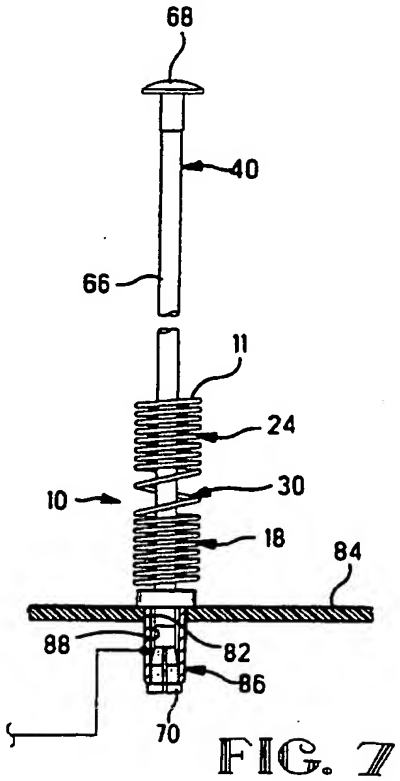

FIG. 7

GB 2 328 084 A

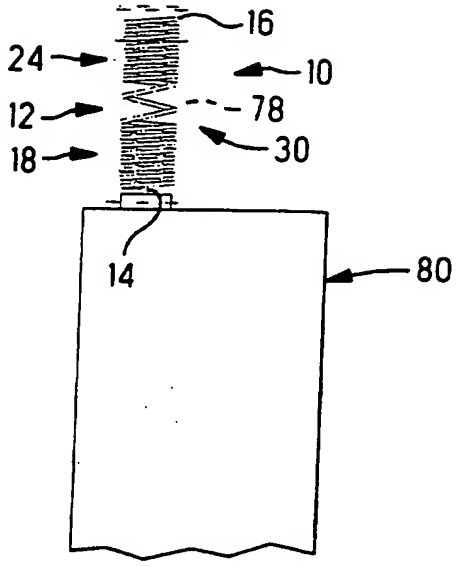

FIG. 1

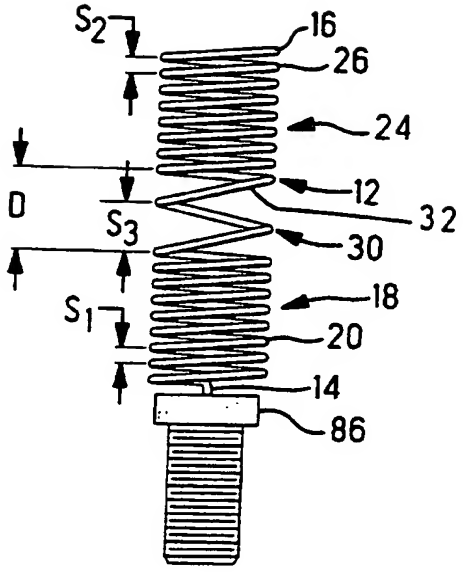

FIG. 2

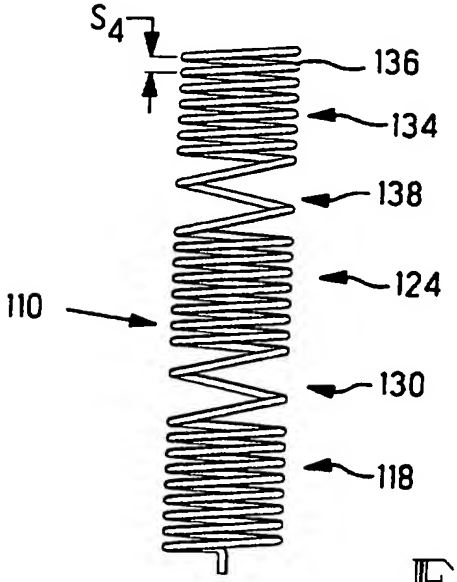

FIG. 3

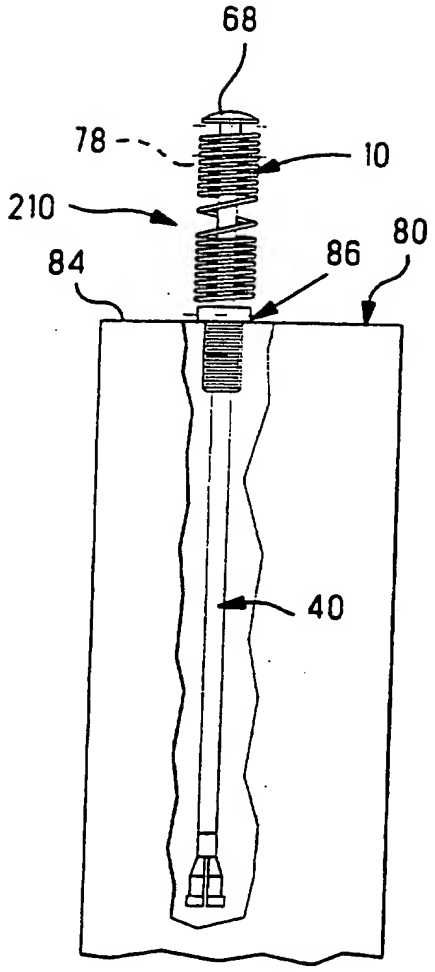

FIG. 4

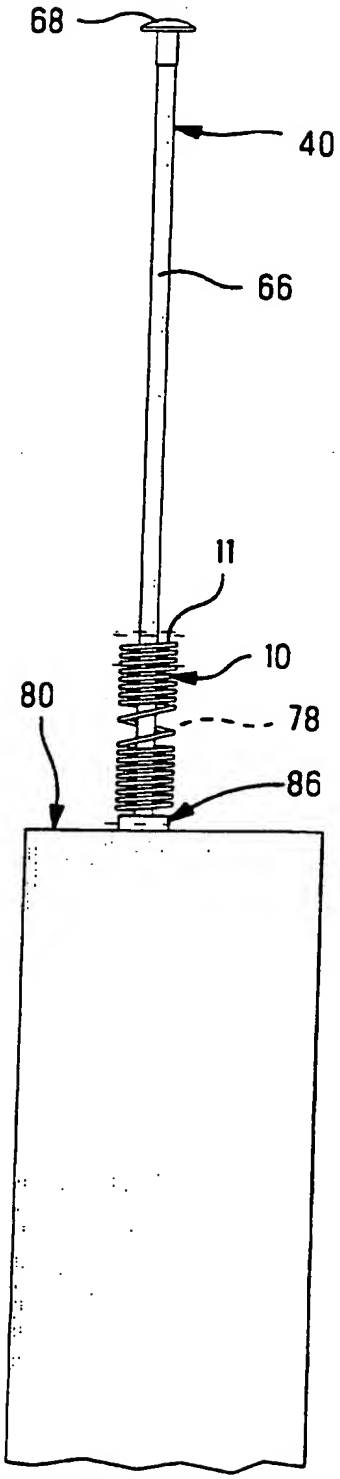

FIG. 5

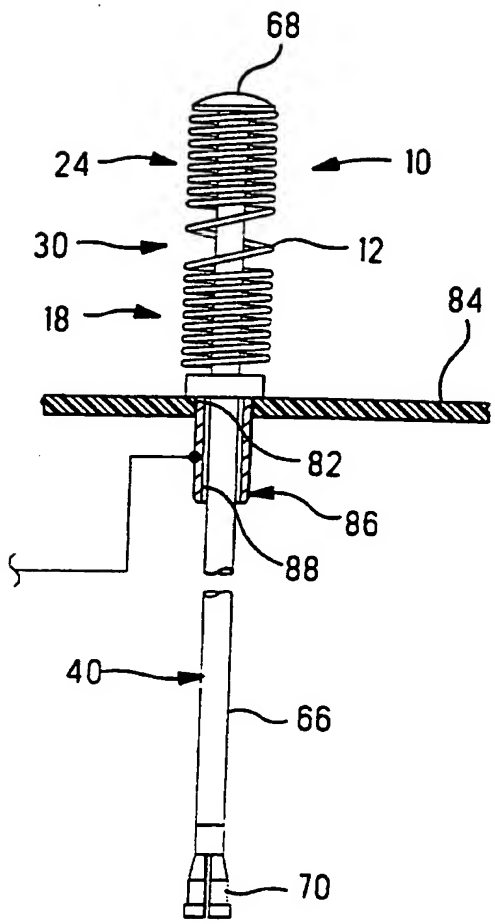
68
24
10
30
12
18
84
82
86
88
40
66
70

FIG. 6

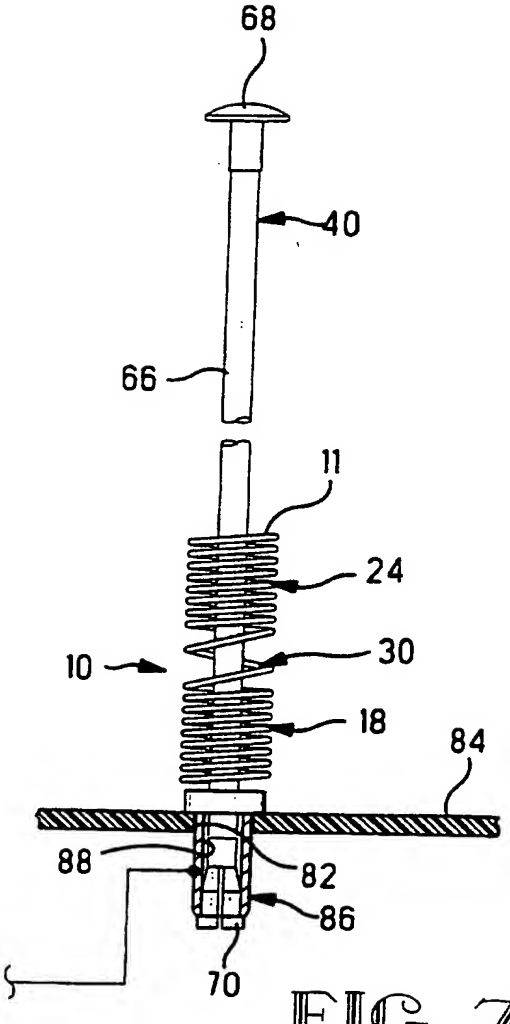
68
40
66
11
24
10
30
18
84
88
82
86
70

FIG. 7

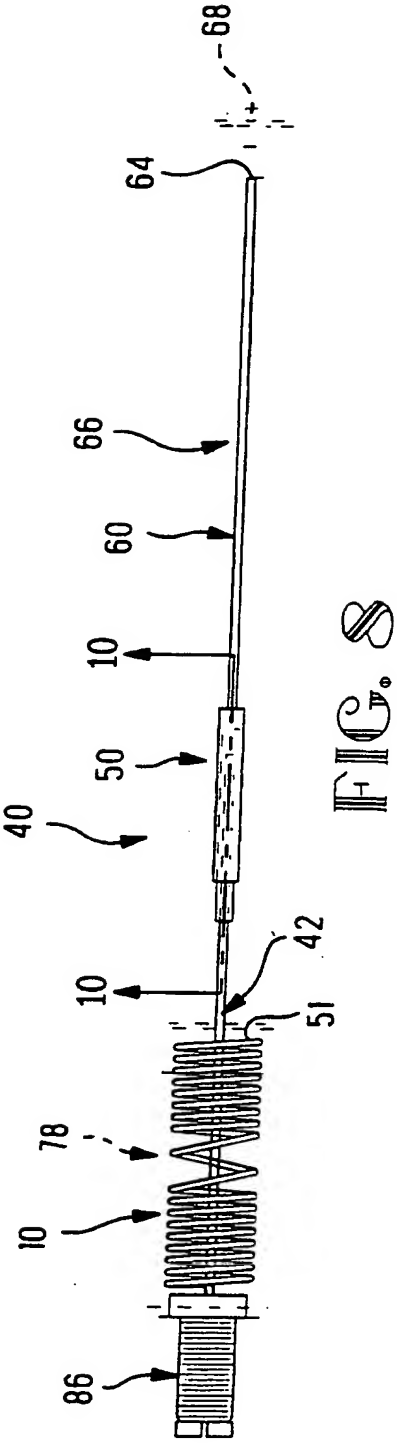

FIG. 8

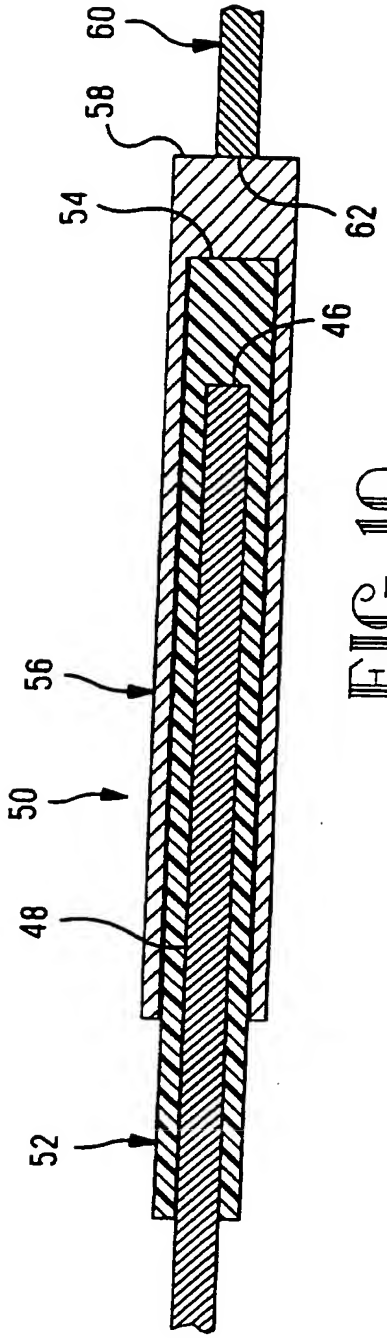

FIG. 10

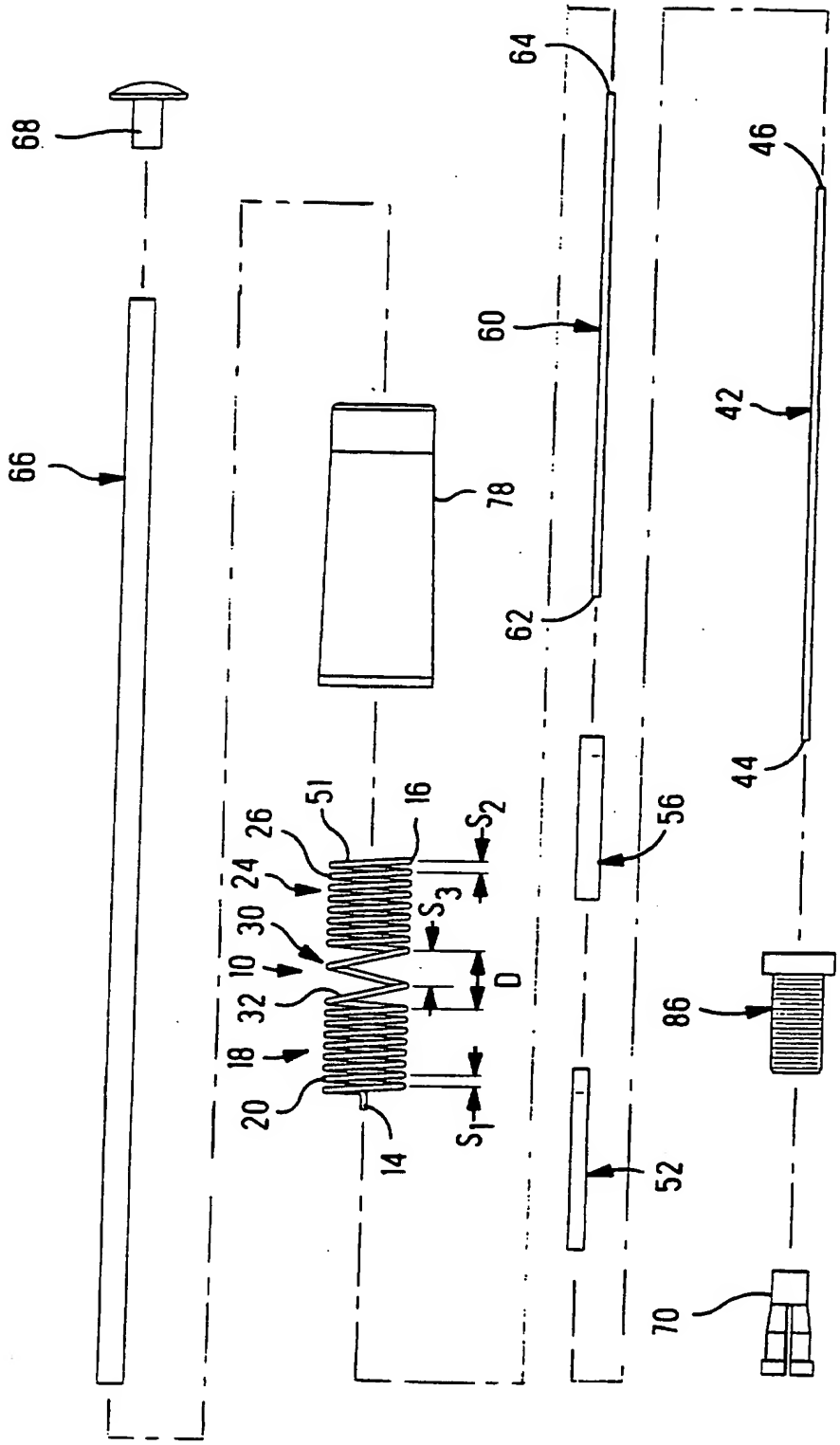
68
66
64
60
62
78
46
42
44
56
86
52
70
51
16
26
24
30
10
32
18
20
14
S_2
S_3
D
S_1

FIG. 9

MULTIPLE BAND ANTENNA

This invention is directed to antennae and more particularly to dual band antennae.

The cellular communications industry including cellular telephones, pagers, and the like use a range of frequencies between 800 and 900 megahertz (MHz). Cellular telephones, pagers, and the like generally use an antenna that is tuned to provide optimum performance in the above frequency range. With the advent of personal communications services (PCS) for providing services such as data transmission, wireless voice mail, and the like, the FCC has established a center frequency of 1.9 gigahertz (GHz) with a suitable band width, well known to one skilled in the art. As the new PCS technology expands, there is a need to provide devices that can receive and transmit communications in both the 800-900 MHz and 1.9 GHz frequency ranges. Cellular telephones and the like, therefore, need to have antennae that will operate in each of the two frequency ranges. One way to achieve this is to provide two separate antennae. It is more desirable and economical, however, to provide a single antenna having at least a dual band capability.

In some instances, it may be desirable that the telephone or the like further includes a rod-like or whip antenna. The rod-like antenna may also be retractable to protect it from damage when the telephone or the like is not being used. Simultaneously, however, it is desirable to provide a non-retractable dual band antenna that retains the capability of transmitting and receiving at least a minimal signal for operation near a remote station.

U.S. Patent No. 5,612,704 discloses a retractable antenna system having a helical antenna mounted on a housing and an elongate retractable antenna mounted within wherein the retractable antenna is arranged to short-circuit the helical antenna when the elongate

antenna is in its extended position. Thus, only one of the two antennae functions at a given time, each one independently of the other. Additionally, during the time that the system is switching from one antenna to the other, no signal can be received.

The present invention is directed to a multiple band coiled antenna. For purposes of illustration the embodiment discussed is a dual band antenna assembly. It is to be understood that the invention is not limited to dual band antennae. The dual band antenna includes a coiled portion having a first end adapted to be terminated to an electrical article. The coiled portion has a first coiled section and at least a second coiled section adjacent and joined thereto by an intermediate portion. The first coiled section has a plurality of windings at a first selected spacing. The second coiled section has a plurality of windings at a second selected spacing. The intermediate portion defines a selected distance that spaces the first and second coiled sections from one another. The selected distance is greater than either one of the first or second selected spacings. The resulting antenna can be tuned to receive frequencies in at least two bands. In the assembled antenna, the first and second coiled sections and the intermediate portion extend along a common axis. The antenna can be tuned to desired frequencies by adjusting the lengths of the various components of the assembly and in particular the distance between the two coiled sections and the spacing between the windings of the intermediate portion.

The present invention is further directed to a retractable multiple band antenna assembly. For purposes of illustration, the embodiment discussed is a dual band antenna assembly having a dual band stationary antenna and a dual band retractable antenna that cooperate with each other to receive signals in two frequency ranges. The stationary antenna is a coiled antenna of the type previously described and defines a channel circumscribed

by the windings thereof. The stationary antenna has one end terminated to a conductive sleeve member secured to a housing of an electrical article and connected to circuitry therein. The sleeve member includes a passageway therethrough in communication with the channel. A retractable rod portion of the antenna assembly extends through the channel and the sleeve passageway and is spaced therefrom. The inner end of the rod portion has an electrical contact thereon adapted to engage a surface of the conductive sleeve member when the rod portion is in its extended position. The retractable rod portion is electrically isolated from the stationary coiled antenna when in the retracted position and is electrically connected to the stationary antenna when in its extended position. The assembly provides continual operation of the antenna during retraction and extension of the retractable antenna and increases the performance of the assembly for sending and receiving signals.

The assembly does not require switching between the two antennas upon extension or retraction of the rod portion and thus can continually receive or transmit signals throughout the retraction or extension process.

It is to be understood that the invention is not limited to dual band antennae and applies to single band as well as antennae having greater than two bands.

In the embodiments shown, the coiled sections are helical. The term "coiled" is not restricted to a helix having a uniform diameter and extends to all coil type antennae. Additionally the term "rod" encompasses whip or coil type antennae having a generally elongate configuration.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a view of the antenna made in accordance with the present invention mounted to an

electrical article and having a protective shroud shown in phantom.

FIGURE 2 is an enlarged view of the antenna of Figure 1.

FIGURE 3 is a view of another embodiment of the antenna made in accordance with the invention.

FIGURE 4 is a view of a further embodiment of an antenna assembly made in accordance with the present invention mounted to an electrical article, the article partially broken away and illustrating a stationary antenna and a retractable antenna in its retracted position with a shroud around the stationary antenna shown in phantom.

FIGURE 5 is a view similar to that of Figure 4 with the retractable antenna in its extended position.

FIGURE 6 is an enlarged fragmentary cross-sectional view of Figure 4 illustrating the antenna assembly mounted in the article.

FIGURE 7 is an enlarged fragmentary cross-sectional view of Figure 5 illustrating the antenna assembly mounted in the article.

FIGURE 8 is an assembled view of the antenna assembly made in accordance with the present invention with the respective outer shrouds shown in phantom.

FIGURE 9 is an exploded view of the antenna of Figure 8.

FIGURE 10 is a cross-sectional view taken along line 10-10 of Figure 8.

For purposes of illustration, the present invention will be described first in terms of a dual band antenna 10 for a cellular telephone. The antenna is also suitable for use with paging devices, two-way hand-held and base unit communication devices, GPS units, computer networking systems, transponders and other like devices.

Referring now to Figures 1 and 2, a dual band coiled antenna 10 includes a wire 12 having first and second ends 14, 16, respectively. First end 14 is adapted for being secured by a screw or other member to

an electrical article 80, such as a cellular telephone, or the like. A dielectric shroud 78, shown in phantom in Figure 1, may be disposed over the antenna 10 for protection.

Wire 12 is wound into a coil including a first coiled section 18 having a plurality of windings 20 at a first selected spacing S_1, and at least a second coiled section 24 having a plurality of windings 26 at a second selected spacing S_2, adjacent and joined thereto by an intermediate portion 30. The intermediate portion 30 defines a selected distance D between the adjacent coiled sections 28, 24 to space the sections from one another. In the embodiment shown, intermediate portion 30 has a plurality of windings 32 at a third spacing S_3. It is to be understood that intermediate portion 30 may be a partial winding, a plurality of windings, or a combination of windings and a substantially straight section. As can be seen from these Figures, the selected distance D is greater than either one of the first and second selected spacings S_1 and S_2. The first and second coiled sections 18, 24 and intermediate portion 30 extend along a common axis. The windings of antenna 10 define a channel 11 extending through the coil. It is to be understood that the selected spacings S_1 and S_2 may be the same or different and that the number of windings in each section may be the same or different.

The upper and lower frequencies of the coiled antenna 10 are defined by the dependent interaction between the first coiled section 18, the second coiled section 24 and the distance D between the two coiled sections 18, 24 provided by the intermediate portion 30 and the spacing of the windings 32 thereof. The antenna can be tuned by adjusting the lengths of the respective coiled sections, the selected spacings S_1, S_2 between the windings 20 and 26 respectively, S_3 between the windings 32 of intermediate portion 30 and the distance D between the two coiled sections 18, 24.

One method of making the antenna is to wind wire 12 into a coil to obtain a selected frequency, then separate the coil at selected locations therealong to provide the spaced apart intermediate portion 30 and the selected spacings between the various windings, as described above to achieve the desired frequencies. The wire may be copper, stainless steel, titanium or the like, as known in the art.

Figure 3 shows another embodiment 110 of the present invention having a first coiled section 118, a second coiled section 124, a third coiled section 134 having windings 136 at a fourth selected spacing S_4, and two intermediate portions 130, 138. The antenna 110 can operate at each of three frequencies. It is to be understood additional coiled sections and intermediate portions may be added to the antenna to provide additional capabilities.

The present invention is also directed to a dual band antenna assembly 210 having a dual band coiled antenna 10 as previously described and a dual band retractable antenna 40, as illustrated in Figures 4 through 10. The same reference numerals are used for the coiled or stationary antenna as described in Figures 1 through 3. The stationary antenna 10 defines a channel 11 circumscribed by the windings thereof. An end 14 of stationary antenna 10 is secured to a conductive sleeve 86 that extends through and is secured in aperture 82 in wall 84 of electrical device 80. Sleeve 86 includes a passageway 88 extending therethrough that is aligned coaxially with channel 11. Retractable antenna 40 extends through channel 11 and sleeve passageway 88 and into the housing of electrical device 80. Sleeve 86 is connected to an electrical circuit of the device, shown representatively in Figures 6 and 7.

Dual band retractable antenna 40, as shown, includes a first wire 42, a dielectric sleeve 52, a conductive ferrule member 56, and a second wire 60. The first wire 42 has a first end 44 that is terminated to a

compliant contact 70 adapted to be received in aperture 88 of sleeve 86 and be electrically engaged thereto when the retractable antenna 40 is in its extended position. The second end 46 of wire 42 is disposed within a dielectric sleeve 52 that extends along a portion 48 of the first wire 42. A conductive ferrule member 56 is disposed over the end 54 of the dielectric sleeve 52, surrounding a portion of the sleeve including some of the first wire 42. The conductive ferrule 56 is electrically isolated from the first wire 42 by the dielectric sleeve 52. The dielectric sleeve 52 and conductive member 56 define a reactive element 50. The retractable antenna 40 further includes a second wire 60 having a second selected length with a first end 62 directly coupled to end 58 of the conductive ferrule member 56 and extending to a second end 64. The first and second wires 42, 60 extend along a common axis. Retractable antenna 40 is covered by an insulating shroud 66 having an end cap 68, which protects the antenna and electrically isolates it from the stationary antenna 10 as it extends through channel 11.

Alternatively, first wire 42 may be an insulated wire that is disposed in conductive member 56, thus eliminating the need for the dielectric sleeve 52.

The upper and lower frequency ranges of the retractable rod antenna 40 are defined by the dependent interaction between the wires and the reactive element. The retractable antenna can be tuned by adjusting the lengths of the wires, the length of the conductive member that extends over the dielectric sleeve, and the length of the portion of the first wire that is overlapped by the conductive member, thus adjusting the reactance of the assembly.

The retractable antenna 40 is assembled by disposing the dielectric sleeve 52 over one end of the first wire 42, disposing the ferrule member 56 over the end of the sleeve 52 and the first wire 42 contained therein. The second wire 60 may be electrically

connected to the end of the ferrule member 56 either before or after the member 56 has been disposed over the sleeve 52. The wires 42,60 may be copper, stainless steel, titanium or the like, as known in the art. The dielectric sleeve may be made from materials such as tetrafluoroethylene, polymethylpentene, polycarbonate or the like, as known in the art. Suitable materials for the conductive ferrule member include copper, brass or similar materials.

The antenna assembly 210 is mounted to the electrical article 80 by use of a conductive sleeve 86. The stationary antenna 10 is secured to the sleeve 86. This assembly is then mounted to the electrical article by inserting the conductive sleeve 86 in aperture 82 of a wall 84 in the electrical article 80, as can best be seen in Figures 4 through 7. Shroud 78 is disposed over the assembled antenna, thereby providing protection for stationary antenna 10. Shroud 78 includes an aperture (not shown) for receiving retractable antenna 40. The retractable antenna 40 is inserted through the opening of shroud 78, through the center of channel 11 of the stationary antenna 10, and passageway 88 of the sleeve 86 and into electrical article 80. The compliant contact 70 is secured to the end of first end 44 of first wire 42. Passageway 88 of sleeve 86 is configured to receive and electrically engage compliant contact 70 when antenna 40 is extended and provide an upper stop surface to prevent antenna 40 from being pulled out of article 80.

When the retractable antenna is its retracted position as shown in Figures 4 and 6, the compliant electrical contact 70 is not engaged with the conductive sleeve 86, the stationary antenna 10 or the electrical circuit of the device. The insulating shroud 66 around the retractable antenna 40 electrically isolates the retractable antenna 40 from the stationary antenna 10. The stationary antenna 10 continues to receive or transmit signals in the selected ranges.

When the retractable antenna 40 is in extended position, as shown in Figures 5 and 7, the compliant contact section 70 is an electrical engagement with a conductive sleeve 86 and, thus, the electrical circuit of the device. Thus, in the extended position of the antenna assembly 210, the dual band stationary antenna 10 cooperates with the dual band retractable antenna 40 to increase the performance of receiving signals and transmitting signals. Both the dual band stationary antenna 10 and retractable antenna 40 are capable of receiving signals in two frequency ranges. Because the stationary antenna 10 is always active, the electrical article 80 can receive or transmit signals throughout the time it takes to extend or retract the antenna 40. The stationary and retractable antennas 10, 40 are tuned to the same frequencies; thus, they cooperate with each other to provide a very effective antenna assembly.

The present invention provides a multiple band retractable antenna that is compact, easily tunable and cost effective to manufacture. It is to be understood that the antenna of the present invention is suitable for use with devices using other frequencies and that additional coiled sections may be added to the stationary antenna. Additional dielectric sleeves, conductive members and wires or insulated wires and conductive members may be added to the retractable antenna to provide an antenna assembly that may receive multiple frequencies.

The present invention provides a multiple band stationary antenna that is compact, easily tunable and cost effective to manufacture. It is to be understood the antenna of the present invention is suitable for use with devices using other frequencies and that additional coiled sections may be added to provide an antenna that can receive multiple frequencies.

CLAIMS:

1. An antenna assembly including a coiled portion having a first end adapted to be terminated to an electrical article, wherein

said coiled portion includes a first coiled section and at least a second coiled section adjacent and joined thereto by an intermediate portion

said first coiled section having a plurality of windings at a first selected spacing S_1;

said second coiled section having a plurality of windings at a second selected spacing S_2; and

said intermediate portion defining a selected distance D that spaces the first and second sections from one another, said selected distance D being greater than either one of said first spacing S_1 and said second spacing S_2;

whereby said antenna can be tuned to receive frequencies in at least two bands.

2. The antenna assembly of claim 1 wherein said first selected spacing S_1 and said second selected spacing S_2 are the same.

3. The antenna assembly of claim 1 or claim 2 further including a third coiled section adjacent said second coiled section and joined thereto by a further intermediate portion said third coiled section having a plurality of windings at selected spacing

said further intermediate portion defining a further selected distance that spaces the second and third sections from one another, said further selected distance being greater than any of said spacings;

whereby said antenna can be tuned to receive frequencies in at least three bands.

4. The antenna assembly of any preceding claim wherein said end of said coiled portion is terminated to a

conductive sleeve and said assembly further includes a rod portion extending through and movable within said first and second coiled sections and said sleeve between an extended and a retracted position;

an end of said rod portion having an electrical contact thereon adapted to engage a surface of said conductive sleeve when said rod portion is in its extended position;

whereby said retractable rod portion is electrically isolated from said coiled portion when in the retracted position and is electrically connected to said coiled portion when in its extended position, thereby increasing the performance of the assembly for sending and receiving signals, said coiled portion providing continual operation of the antenna assembly during retraction and extension of the rod portion.

5. An antenna assembly comprising:

a stationary coiled antenna defining a channel circumscribed by windings thereof and having one end terminated to a conductive sleeve member secured to a housing of an electrical article said sleeve member including a passageway therethrough in communication with said channel

a retractable rod antenna extending through said channel and said sleeve passageway and spaced therefrom, an end of said antenna having an electrical contact thereon adapted to engage a surface of said conductive sleeve member when said rod antenna is in its extended position;

whereby said retractable antenna is electrically isolated from said stationary antenna when in the retracted position and is electrically connected to said stationary antenna when in its extended position, thereby increasing the performance of the assembly for sending and receiving signals, said

coiled portion providing continual operation of the antenna assembly during retraction and extension of the retractable rod antenna.

6. An antenna assembly substantially as herein described and as shown in the accompanying figures.

The Patent Office

L3

Application No: GB 9816105.2 **Examiner:** Gareth Lewis
Claims searched: 1 to 4 **Date of search:** 26 October 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H1Q (QAA, QAX, QDA, QDH, QDJ, QDX, QJC)

Int Cl (Ed.6): H01Q 1/36, 11/08, 21/30

Other: Online : WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US 5258765	Dorrie (drawing, abstract, and col. 1 line 64 to col. 2 line 11)	1
X	US 4169267	Wong (figure 1, and col. 1, lines 49-64)	1,2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.